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Revision 2

Solid Waste Management Facility Handling and Processing of Flammable Drums on SWMF TRU Waste Pads

Justification for Continued Operation

January 2005

Westinghouse Savannah River Company
Aiken, SC 29808

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PREPARED FOR THE U.S. DEPARTMENT OF ENERGY UNDER CONTRACT NO. DE-AC09-96SR18500

Solid Waste Management Facility
Handling and Processing of Flammable Drums on SWMF TRU Waste Pads
Justification for Continued Operation (U)

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1.0 Introduction

1.1 Purpose

This Justification for Continued Operation (JCO) addresses 295 unvented transuranic (TRU) waste drums currently stored outside of culverts on TRU Waste Pads (see definition below) as result of a discovery Unreviewed Safety Question (USQ) (Ref. 1) that shows the potential for an increase in the frequency and/or consequences associated with the deflagration of unvented TRU waste drums with a flammable headspace gas mixture. There are approximately 3000 such unvented drums. Of these 3000 drums, the 295 currently on TRU Waste Pads pose an immediate risk. Safe handling practices will be identified to transfer the unvented drums to TRU Waste Pad 6, location of the Drum Venting System (DVS), and process the unvented drums through the DVS. These controls will also apply to the movement as necessary of volatile organic compound (VOC) drums stored on TRU Waste Pads subject to compensatory measures of Reference 5. Consequences to the MOI (Maximally exposed Off-site Individual) and the co-located (100 meter) worker consequences resulting from these activities are bounded by the discovery USQ. The controls established mitigate impact of an accident to the facility worker in close proximity to the drums. Although there are 295 unvented drums identified on the TRU Waste Pads, this JCO applies to any unvented drums discovered on the pads. A later revision to the SWMF Safety Basis will address safe handling and mitigation of culvert stored potentially flammable drums.

1.2 Definitions

1.2.1 Unvented Drums

TRU waste drums that have not had any filter vents installed. This definition also includes undervented drums that are those drums that have at least one vent installed but potentially an insufficient number of vents installed to control the hydrogen concentration below the Lower Flammable Limit (LFL).

1.2.2 VOC Drums

Vented TRU waste drums that have not been proven to have a steady-state VOC concentration below the LFL. This includes unvented drums that have undergone vent and purge (V&P) and determined to be potentially flammable for VOCs prior to purging.

1.2.3 Potentially Flammable Drums

A group of TRU waste drums that include both subsets defined above (unvented and VOC drums). Potentially flammable drums are the drums in the SWMF that may contain a flammable atmosphere.

1.2.4. Undetermined Drum (UD Drum)

A TRU waste drum that has a suspect reported generator quantity or an unknown PEC quantity.

1.2.5. Drum in Process / Processing

A drum being moved or handled (e.g., touched) or during drilling in the V&P cycle where the drum is assumed to have a higher potential for deflagration due to the introduction of an ignition source. Purging of a drum is not considered processing because the drum is stationary in a confined cabinet and not subject to possible movements that would introduce an ignition source.

1.3 Scope

This JCO will establish safe handling practices as compensatory measures that will allow movement and processing of the unvented TRU waste drums from their current storage location on the TRU Waste Pads through the DVS on TRU Waste Pad 6. Compensatory measures will augment the existing TSR controls (ref. 10). The identified compensatory measures are applicable to drum handling and movement operations on all TRU Waste Pads housing potentially flammable drums.

This JCO establishes safe conditions and handling practices to allow the following operations to be performed:

- Movement of VOC drums as necessary to access both unvented drums and fully characterized drums being prepared for shipment to Waste Isolation Pilot Plant (WIPP).
- Removal of potentially flammable drums from the storage arrays
- Visual inspection of potentially flammable drums for drum integrity
- Transfer of unvented drums from storage pad locations to the DVS.
- Transfer of potentially flammable drums from storage pad locations to the DVS or from one storage pad location to another storage pad location.
- Handling of unvented drums during the DVS operations
- Handling and removal of an existing single VOC drum currently in the DVS, as well as, unvented drums requiring purge for VOCs, which supersedes the compensatory measures identified in Reference 5.
- Responding to drums dispositioned by the drum inspection program during the execution of this JCO.

Implementation of this JCO will reduce the overall risk of facility operations by allowing the removal of these unvented drums from the TRU Waste Pads and their processing through the V&P process. The basis for this risk reduction is two fold:

1. The risk associated with hydrogen-rich unvented drums is eliminated since it has been demonstrated that such drums after exiting V&P are consistently rendered nonflammable when steady state is restored.

2. Although this JCO conservatively assumes that all unvented drums with an initial VOC concentration greater than 1 volume percent[1] will be potentially flammable after exiting the V&P process, based on the recent V&P campaign where 1854 drums underwent V&P, no drums were subsequently determined to be potentially flammable when processed through the WIPP-certified headspace gas sampling unit. Therefore, it is expected that after processing the unvented drums through V&P a small percentage will re-establish a potentially flammable VOC headspace concentration.

2.0 Statement of Problem

2.1 Discovery of Flammable Unvented TRU Waste Drums

During the most recent V&P campaign, the Solid Waste Management Facility (SWMF) vented TRU waste drums in preparation for permanent disposal at WIPP in New Mexico. Some of these drums have been identified as containing flammable mixtures of hydrogen and oxygen. Based on this new information, a PISA was declared (Ref. 2). A subsequent Unreviewed Safety Question Detemination (USQD) (Ref. 1) was performed and found that the condition resulted in an USQ.

A review of headspace gas sampling results for the most recent V&P campaign starting in August 2003 indicate that out of 1854 unvented drums processed through V&P, 102 (5.5%) were hydrogen flammable[2] (Ref. 3). A subsequent screening of the data also suggests that about one third of the unvented drums could have been potentially VOC flammable[3] prior to entering V&P. For the purpose of this JCO, all unvented drums are conservatively assumed to be flammable in concentrations sufficient to eject the lid.

Drum deflagrations are reported as Unlikely events in the SAR (Ref. 6). However, with the discovery of the potentially flammable unvented drums plus the likelihood for more potentially flammable unvented drums to exist in the remaining population stored on TRU Waste Pads the frequency of a drum explosion is estimated now to be Anticipated for the remaining unvented population stored on TRU Waste Pads (Ref. 1).

3.0 Status of the Facility

Current status of the facility at the writing of this JCO is as follows:

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[1] The threshold for potentially VOC flammable drums in the V&P machine is conservatively set at 1 vol % (or 10,000 ppm) total VOCs. The actual LFL for the VOC headspace gas mixture would most likely be higher based on the varying flammability of the individual VOCs present.
[2] Hydrogen greater than 4 vol % and oxygen greater than 5 vol % (Ref. 11).
[3] Total VOCs greater than 1 vol % and oxygen greater than 8 vol % (Ref. 11).

- TRU Waste Pads and affected facilities as identified in Reference 4 are in a Standby Mode.
- A single VOC drum undergoing V&P processing remains in the DVS machine.
- A population of VOC drums commingled with unvented drums is currently subject to the compensatory measures described in Reference 5.

The identified inventory of unvented TRU waste drums are stored on pallets and stacked in arrays in accordance with current acceptable practice as described by the SAR (single-tier, two-tier high or three-tier high arrays) (Ref. 6).

4.0 Risk of Continued Operations

Due to the discovery of potentially flammable hydrogen-oxygen mixtures in unvented drums it has been determined that some of the unvented drums currently located on the TRU Waste Pads may have a flammable mixture of hydrogen and oxygen. When these unvented drums are retrieved from an array, multiple drum handling steps are required depending on the stored position in the array of drums. Since the highest consequence of an accident would be related to the facility worker during these multiple processing steps, compensatory measures will be implemented before the continuation of processing operations. In the event of a deflagration, a Hanford study concluded that drum deflagrations can eject waste and continue to burn after the deflagration (Ref. 12). However, the resulting fire is not expected to propagate to other waste containers (Ref. 6).

Drums are stacked on TRU Waste Pads in accordance with the requirements established by the SAR (stacked up to three tiers high). The accident analysis assesses two different ways that containers can be damaged by seismic events: (1) falling from a stacked array due to sliding and (2) overturning. It is expected that the contents of unvented drums involved in a fall from the third tier of a stacked array will breach and deflagrate, however, a fall from the second tier or a drum on the ground overturning or being jarred has the conditional probability of deflagrating of approximately 1.0E-03 (Ref. 7).

Reordering the identified population of unvented drums into a single tier (i.e., non-stacked array) would require additional handling. Due to limited storage space on the TRU Waste Pads the drums cannot be reordered in single array. This reordering would require the drums to be relocated to other TRU Waste Pads; thereby requiring additional handling steps. Therefore, due to the limited storage time associated with processing unvented drums (on the order of weeks) through V&P to a safer condition, as compared to the frequency of a seismic event, restacking the unvented drums into a single level would unnecessarily increase the risk to the facility worker and is not justified.

Executing this JCO may require movement of VOC drums; and therefore, will take precedence over the compensatory measures provided in Reference 5 for only those VOC

drums impacted. The movement and handling of these VOC drums will be in accordance with the controls established for unvented drums, with the exception that they may be stacked up to two tiers high.

One VOC drum is currently located in the Drum Venting System (DVS) machine on TRU Waste Pad 6. The current PISA (Ref. 5) prevents the handling of VOC drums. However, this JCO allows the processing of this drum and any unvented drums that may be discovered to contain levels of VOCs exceeding the TSR limits. As a result, these drums will be purged, removed from the DVS machine and if necessary placed in an isolation area or placed in storage in accordance with this JCO.

The most severe radiological and physical hazards to the facility workers results from the deflagration of flammable drums. Therefore, in order to minimize the risk to the operator, all potentially flammable drums shall be moved by a standard industrial forklift to protect the operator from a possible lid ejection in the event of a deflagration. The forklift feature that is credited with protecting the operator is the height and robustness of the mast. This feature will be evaluated and documented in an engineering calculation to ensure adequate protection is afforded to the forklift operator in the event a drum lid is ejected during a drum deflagration. The cab of the forklift will be enclosed to provide an environment for the operator to don a respirator in the event of a deflagration. During manual drum handling activities where potentially flammable drums may be contacted (e.g., banding, positioning drums in the V&P machine)[4], workers will use safe handling techniques that keep their upper body (i.e. head and torso) from being over top of a potentially flammable drum. As defense-in-depth, workers will use remote handling tools to contact potentially flammable drums. After the drum has been processed through the V&P, and demonstrated to not have contained a potentially flammable headspace prior to venting, the drum may be handled as a nonflammable drum using established safe handling techniques.

Drums containing greater than a reported 450 PEC[5] will not be handled and pallets containing greater than a reported 520 PEC will not be moved in the scope of this JCO. The 450 PEC value bounds the highest inventory single potentially flammable drum currently located on the TRU Waste Pads. These drums are in high-drum temporary storage areas (HD TSAs) and not stacked. The 520 PEC value bounds the highest inventory for a single pallet of potentially flammable drums stored in a non-HD TSA based on a reported 130 PEC/drum and stacked up to three high.

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[4] The few drum deflagrations associated with flammable gas mixtures that have occurred in the DOE complex have occurred during drum handling or processing activities. Therefore, given that a drum deflagration is a relatively rare event considering the vast number of drums in the DOE Complex, a stationary drum represents a relative safe condition. It should be noted that if a drum has the potential to be jostled it is not assumed to be safe (e.g. Radcon contamination surveys, banding, cleaning, etc.). Any physical contact with a drum is assumed to jostle the drum.

[5] PEC content is typically provided by the generator, and in some cases, is under reported. This uncertainty is qualitatively considered when selecting controls to protect facility workers.

A non-HD TSA array involved in the event may contain UD drums; however, it is not expected that a UD drum involved in the bounding accident would exceed 130 PEC for the following reasons:

- For the UD drums with suspect generator reported quantities, PEC quantities are assigned based on a statistical analysis of a similar population with assayed values (Ref. 14). Reference 14 shows that the likelihood of a UD drum being greater than 130 PEC is less than 2E-03 (4 out of 2,574 at a 97% confidence level). Of these original 2,574 UD drums, 2,521 have been assayed with the average drum inventory being less than 2 PEC/drum (Ref. 15).

- For the UD drums with no known PEC values, the highest quantity expected is 6.5 PEC/drum (Ref. 16) based on available generator records that have not been matched to their associated drums in this population. A possible 137 additional UD drums with suspect generator reported quantities may exist in the population of drums with no matching generator records. It is expected that the PEC values for these drums are consistent with the PEC values for the 2,521 UD drums already assayed.

In the bounding accident a forklift impacts a tier of drums in a TRU Waste Pad array. The event causes the top two tiers of drums to fall along with a pallet being carried by the forklift at the time of the accident. The maximum inventory involved is estimated to be 1170 PEC. This value is based on all the drums on the top row and all the drums being transported by the forklift falling and deflagrating when breached, plus one drum from the two lower rows deflagrating as a result of being jarred/falling [(4 top row drums + 4 forklift drums + $(8 \times 1.0E\text{-}03)_{\text{rounded up}}$ bottom and middle row drums) x 130 PEC/drum = 1170 PEC]. The table below presents the potential consequences from this event.

Bounding Accident					
Inventory (PEC)	ARF*RF	100m DCF* (rem/PEC)	MOI DCF* (rem/PEC)	Dose @100 (rem)	Dose @ MOI (rem)
1170	1.00E-03	42	8.3E-02	4.9E+01	9.7E-02

* DCFs are from Reference 9.

The current SAR identifies two vehicle events that may initiate a deflagration (Ref. 6). 1) The first event occurs when a "non-pad vehicle" (i.e., truck, tractor, etc.) impacts the materials stored on the TRU Waste Pad. The expected frequency is between 1E-04/year and 1E-06/year or Extremely Unlikely. The existing TSR traffic controls adequately address the increased risk associated with the added number of potentially flammable drums being involved in the event. 2) The second event involves a pad vehicle (i.e., forklift, drum handler, etc.) traveling at low speed and impacts the material stored on the TRU Waste Pad. The expected frequency of this event is greater than 1E-02, or Anticipated. The identified population of unvented drums is now considered at risk due to the potentially flammable contents of the drums. Due to the potentially flammable

condition of the drums, no vehicle operations will be allowed on the affected TRU Waste Pads, other than the forklift associated with the moving and handling activities addressed in this JCO. Also, prior to beginning pad-to-pad transfers of potentially flammable drums all traffic along the travel route shall be prohibited. As defense-in-depth the travel route will be assessed for traffic hazards before the transfer begins.

To reduce the risk of handling potentially flammable drums located on the second or third level of an array, one pallet at a time will be removed. Only a single pallet of up to four potentially flammable drums or a single non-palletized potentially flammable drum may be in process on an individual TRU Waste Pad at any time during the drum process operations. When a forklift is carrying a pallet of potentially flammable drums or an individual potentially flammable drum, the load will be set on the ground and forklift secured when the drums need to be approached (e.g., Radcon surveys, drum inspection). An outer perimeter visual inspection of drums (i.e., sides and lid area for signs of pressurization, excessive corrosion, signs of impact damage) must be performed before transporting potentially flammable drums to the DVS machine.

This JCO authorizes the handling and movement of potentially flammable drums to access fully characterized drums. Although the movement of fully characterized drums is an evaluated and safe activity, it requires workers to operate near potentially flammable drums. Thus, while on pads housing potentially flammable drums, the movement of these fully characterized drums will be subject to the controls of this JCO. Shipping of fully characterized drums to WIPP reduces facility risk by reducing the radiological inventory stored on TRU Pads, and freeing up TRU Waste Pad space to provide buffer for potentially flammable drums.

A drum inspection program is in place to ensure bulged drums or drums with questionable structural integrity are evaluated for disposition. In the event a drum is determined to present a hazard during the execution of this JCO, the suspect drum will be dispositioned as follows:

- If a leaking or contaminated drum or a drum in a weakened condition is found, it will be overpacked using the control strategies for potentially flammable drum movement and handling described in this JCO. Overpacked drums will be moved to an isolated area for later processing.
- If a bulged drum is encountered, it will either be taken to the DVS staging area in accordance with the controls in this JCO for non-bulged unvented drums or overpacked and moved to an isolated area for later processing. Bulged drums taken to the DVS staging area shall be processed through the V&P process on a priority basis.

An access restriction program will ensure only personnel involved in the drum processing will be on the affected TRU Waste Pad during operations (e.g., forklift operator, Radiological Control Operator (RCO), forklift spotter, DVS operator). Access to the TRU Waste Pads where potentially flammable drum operations are occurring will be restricted. During drum handling and moving activities, workers in the access-restricted

area shall wear hardhats and safety glasses, except for the forklift driver while in the cab, and operators in the DVS control room. The DVS control room is remote to the DVS unit and the enclosed control room provides comparable protection to a hard hat and safety glasses.

For the retrieval and subsequent handling and movement of potentially flammable drums, Radcon will establish a safe standoff area surrounding the drum processing operations where respiratory protection is required. Personnel within the standoff area must wear respirators, except for the forklift operator and operators in the DVS control room who are protected by their position in the enclosed cab of the forklift and control room from the immediate effects of a radiological release. The forklift driver and the operators in the DVS control room are required to have respirators present in the forklift cab and control room for use during an accident associated with handling and movement of potentially flammable drums (e.g., drop drum, deflagration, puncture from forklift tine).

For potentially flammable drum movement from pad-to-pad lid restraining controls on each potentially flammable single drum or pallet of drums (up to 4 drums) are required to protect against waste ejection that may impact workers outside the access-restricted area in the event of a deflagration during the moving process, and are to be in place prior to the start of the transfer. However, for movements of potentially flammable drums on the same TRU Waste Pad, lid-restraining devices are not required because these operations are inside an access-restricted, covered facility with protective compensatory measures already in place.

After removal from a storage array, inspected and found to be in satisfactory condition, pallets containing unvented drums or an individual drum shall be directly transported to the DVS staging area on TRU Waste Pad 6 and not stacked. Once a pallet containing potentially flammable drums is staged waiting V&P, one unvented drum at a time shall be removed from a pallet. A spotter, qualified on forklift operations, will assist the forklift operator in properly seating the drum on the DVS dolly. Once properly seated, the spotter will exit to the defined standoff area before the maxi-gripper completely releases control of the drum. To draw out one unvented drum and place it in the V&P machine, safe handling practices that ensure the upper body (i.e. head and torso) is not placed over the drum is used along with defense-in-depth remote handling tools until the unvented drum has been secured in the DVS machine (process repeats until all unvented drums have been processed through the DVS machine). By processing these unvented drums through V&P the risk associated with operations on the TRU Waste Pads is reduced.

Any unvented drums that may be discovered to contain levels of VOCs exceeding the TSR limits will be purged in accordance with TSR controls. If a VOC drum cannot achieve the TSR limit for percentage of VOCs in the vapor space after purging for greater than 8 hours total purge and sample time, it may be removed from the DVS. This duration is based on operating experience gained during the recent V&P campaign where over 96% of the VOC drums were able to be successfully purged below TSR VOC

headspace limits in less than 8 hours of total purge and sample time. Such drums will be placed in a designated isolation area for later processing. This strategy allows unvented drums to be processed at a faster rate and still require the potentially flammable VOC drums to be managed safely until such time they can be purged. Unvented drums that are determined to be potentially flammable for VOCs will be handled and moved as potentially flammable after exiting V&P unit in accordance with controls identified in this JCO.

Drums that require purging to achieve a headspace gas concentration below TSR VOC limits will have a calibration check performed on the V&P gas chromatograph prior to and within 24 hours of any measurement used to determine that the headspace is not flammable, in accordance with TSR controls. This control ensures valid gas analysis results for the drum being sampled without interrupting the purge cycle where an operator must access the potentially flammable drum to configure the DVS for calibration.

VOC drums that travel with unvented drums or with fully characterized drums (hereafter referred to as "VOC traveler drums") will be staged until ready for transport to a storage location. If these drums are to be placed into an array, they will not be placed in the third tier. VOC traveler drums will be handled as potentially flammable, subject to the controls placed on the handling and movement of unvented drums.

5.0 Compensatory Measures

To ensure that the continued risk of operating the TRU Waste Pads is bounded by the existing accident analyses and that adequate protection is provided for facility workers, the following compensatory measure shall be implemented and considered TSR-level controls during the execution of this JCO based on functional classification provided in Reference 13:

1. Drums with a reported value of 450 PEC or greater shall not be handled.
2. No potentially flammable drums in a HD TSA shall be stacked.
3. Pallets with potentially flammable drums with a total reported value of 520 PEC or greater shall not be moved.
4. Only one individual potentially flammable drum or a single pallet of up to four potentially flammable drums may be in process on an individual TRU Waste Pad at any time during drum processing operations. Only one individual potentially flammable drum or one pallet of potentially flammable drums may be in transport between TRU Waste Pads at any time.
5. The V&P process shall be restricted to processing of unvented drums as well as the VOC drum currently in the DVS machine.
6. Unvented drums that are removed from a storage array and determined to be in good condition, shall immediately (without undue delay) be transferred, using the

required safe handling procedures, to TRU Waste Pad 6 to undergo V&P. Unvented drums shall not be replaced into a stacked configuration once they have been removed from an array.

7. An individual potentially flammable drum or a pallet of potentially flammable drums will be lowered to the ground and the forklift secured prior to approaching drum (e.g., Radcon surveys, drum inspections), except when positioning a single drum on the DVS dolly.
8. All traffic along the travel route from pad-to-pad, except for the forklift engaged in the activity, shall be prohibited during the transfer of potentially flammable drums.
9. Access control shall be established to restrict personnel to the TRU Waste Pads and along the travel route to workers essential to the activity in progress while potentially flammable drum operations are underway.
10. Personnel in an access-restricted area shall wear hardhats and safety glasses during the handling and movement of potentially flammable drums, except for the forklift driver while in the cab and personnel in the DVS Control Room.
11. No vehicle operations will be allowed on the TRU Waste Pads with potentially flammable drums, other than the forklift associated with the handling and movement activities addressed in this JCO.
12. The training program shall address safe drum handling techniques that prohibit the worker from placing the upper body (i.e. head and torso) over potentially flammable drums.
13. The Radiation Protection Program shall establish a safe standoff distance on the TRU Waste Pads and along the travel route during the potentially flammable drum processing. When inside this area respiratory protection is required with the exception of the forklift driver who has a respirator readily available in the cab and personnel in DVS Control Room who have respirators readily available in the DVS Control Room.
14. A forklift with an enclosed cab shall be used to move drums on TRU Waste Pads with potentially flammable drums.
15. Forklifts used for the movement of potentially flammable drums shall have a mast configuration that when retracted, provides protection to the forklift operator from an ejected drum lid in the event of a drum deflagration. The forklift feature that is credited with protecting the operator is the height and robustness of the mast.
16. A drum inspection program is in place to ensure bulged drums or drums with questionable structural integrity are evaluated for disposition. In the event a drum is determined to present a hazard during the execution of this JCO, the suspect drum will be dispositioned as follows:
    - If a leaking or contaminated drum or a drum in a weakened condition is found, it will be overpacked using the control strategies for potentially

flammable drum movement and handling described in this JCO. Overpacked drums will be moved to an isolated area for later processing.

- If a bulged drum is encountered, it will either be taken to the DVS staging area in accordance with the controls in this JCO for non-bulged unvented drums or overpacked and moved to an isolated area for later processing. Bulged drums taken to the DVS staging area shall be processed through the V&P process on a priority basis.

17. Drum lid restraining controls shall be in place on each potentially flammable single drum or pallet of drums (up to 4 drums) prior to and during transport from pad-to-pad. Once placed on a TRU Waste Pad, the drum lid restraining controls may be removed.

    The safety function of the drum lid restraining controls is to ensure waste ejected during a deflagration is not widely dispersed. The following design attribute ensures the safety function is met.

    - Constructed of material and built to a thickness capable of deflecting expelled waste resulting from a drum deflagration.

18. While positioning an unvented drum at the DVS, a spotter, qualified on forklift operations, will assist the forklift operator in properly seating the drum on the DVS dolly. Once properly seated and before the maxi-gripper completely releases control of the drum, the spotter shall exit to the defined standoff area.

19. VOC drums moved as part of the execution of this JCO shall be placed in a storage array or placed in a safe location on a TRU Waste Pad. The movement and handling of these VOC drums will be handled as potentially flammable in accordance with the controls established for unvented drums, with the exception that they may be stacked up to two tiers high.

20. Drums processed under this JCO and determined to have an initial VOC concentration greater than 1 volume percent will be handled and moved as potentially flammable after exiting V&P in accordance with controls identified in this JCO.

6.0 Exiting the JCO

This JCO may be exited when subsequent Safety Basis documentation supersedes this JCO.

7.0 References

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